ARI Research Note 99-36

High Payoff Tasks for Training Soldiers and Small Unit Leaders in Virtual Environments

Robert J. Pleban
U.S. Army Research Institute

Infantry Forces Research Unit
Scott E. Graham, Chief

September 1999

U.S. Army Research Institute
for the Behavioral and Social Sciences

U.S. Army Research Institute
for the Behavioral and Social Sciences

A Directorate of the U.S. Total Army Personnel Command

EDGAR M. JOHNSON
Director

Technical review by

Richard E. Christ
Donald R. Lampton

NOTICES

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave Blank)*

2. REPORT DATE
September 1999

3. REPORT TYPE AND DATES COVERED
Final, 1/99-9/99

4. TITLE AND SUBTITLE
High Payoff Tasks for Training Soldiers and Small Unit Leaders in Virtual Environments

5. FUNDING NUMBERS
62785
A790
202b

6. AUTHOR(S)
Robert J. Pleban (U. S. Army Research Institute)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Research Institute for the Behavioral and Social Sciences
ATTN TAPC-ARI-IJ
PO Box 52086
Fort Benning, GA 31995-2086

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Research Institute for the Behavioral and Social Sciences
5001 Eisenhower Avenue
Alexandria, VA 22333-5600

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
Research Note 99-36

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This report describes a multi-tiered process for identifying potential high payoff tasks for training small unit dismounted Infantry soldiers in simulated urban operations. Two recently created lists of Infantry tasks and battle drills were evaluated. Four selection criteria were applied: 1) the capability of current and near-term individual combatant simulator systems to support specific task-related behaviors; 2) the potential transfer effectiveness of practicing these tasks in a virtual environment; 3) the frequency with which task components (behaviors) are performed and; 4) the cost effectiveness/feasibility of performing the task in the virtual environment. Five tasks and five subtasks were retained for subsequent development into training scenarios. The tasks included Assault, Move Tactically, Enter Building and Clear a Room, Reconnoiter Area, and React to Contact. The subtasks included Engage Targets with an M16A1 or M16A2 Rifle, Move as a Member of a Fire Team, Control Movement of a Fire Team, Perform Movement Techniques During MOUT, and Report Information of Potential Intelligence Value. The training scenarios will be evaluated in the Land Warrior Test Bed. These evaluations will help confirm the value of virtual environment simulations as a rehearsal tool for soldiers and small unit leaders.

14. SUBJECT TERMS Virtual environments, Individual combatant simulators, Dismounted Infantry simulation

15. NUMBER OF PAGES
21

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

NSN 7540-01-280-5500

Standard Form 298 (Rev 2-89)
Prescribed by ANSI Std 239-18 298-102

Research Note 99-36

High Payoff Tasks for Training Soldiers and Small Unit Leaders in Virtual Environments

Robert J. Pleban
U.S Army Research Institute

Infantry Forces Research Unit

Scott E. Graham, Chief

U.S. Army Research Institute for the Behavioral and Social Sciences
5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600

September 1999

Army Project Number
20262785A790

Personnel Systems and Performance
Technology

FOREWORD

This report describes a multi-tiered process for identifying potential high payoff tasks for training small unit dismounted Infantry soldiers in simulated urban operations. The result is a set of key tasks that can be cost effectively represented in virtual environments. This research was conducted by the U.S. Army Research Institute's (ARI) Infantry Forces Research Unit under a Science and Technology Objective (STO) entitled *Virtual Environments for Dismounted Soldier Simulation, Training, and Mission Rehearsal.* The ARI, the U.S. Army Simulation, Training, and Instrumentation Command (STRICOM), and the U.S. Army Research Laboratory have joined in a collaborative effort focusing on selected technological and training issues related to high fidelity dismounted soldier simulation. The current effort lays the groundwork for the development of soldier and small unit leader training scenarios that will be evaluated at the Dismounted Battlespace Battle Lab (DBBL), at Fort Benning, Georgia.

This research will improve the utilization of virtual environments for training soldiers and small unit leaders. Task-based training simulation scenarios will enable soldiers to respond to a variety of battlefield situations at reduced cost to the unit in either training time or actual expense. Extensive exposure to simulations will allow soldiers to familiarize themselves with specific aspects of selected tasks. The identified high payoff tasks, combined into scenarios, will improve training for dismounted soldiers and small unit leaders and leverage the potential of virtual simulations. The results of this research were briefed to all key STO participants, including the Chief of the DBBL Simulation Center, at a STO meeting on 27 May 1999.

HIGH PAYOFF TASKS FOR TRAINING SOLDIERS AND SMALL UNIT LEADERS IN VIRTUAL ENVIRONMENTS

EXECUTIVE SUMMARY

Research Requirements:

Soldiers must be able to train effectively even when they do not have the opportunity to participate in realistic field training exercises. Simulations are needed that develop soldier decision making and leadership skills through repeated practice and rehearsal. Until recently, individual virtual environments have been unable to provide the richness of environmental cues and/or adequate response sensing mechanisms to be considered useful substitutes for natural world alternatives. Emerging virtual environment technologies have attempted to address some of these deficiencies. However, limitations in both hardware and software and lack of documented training approaches for the use of these technologies must still be addressed. There is an immediate need to generate a set of high payoff tasks that can be cost effectively represented in virtual environments. These tasks will provide the foundation for the development of soldier and small unit leader training scenarios.

Procedure:

Two lists of Infantry tasks and battle drills were evaluated. Four selection criteria were applied: 1) the capability of current and near-term individual combatant simulator systems to support specific task-related behaviors; 2) the potential transfer from practicing these tasks in a virtual environment; 3) the frequency with which task components (behaviors) are performed and; 4) the cost effectiveness/feasibility of performing the task in the virtual environment.

Findings:

Twenty-three potentially suitable tasks were identified. Five tasks and five subtasks were retained to form the basis of the training scenarios. The tasks were *Assault, Move Tactically, Enter Building and Clear a Room, Reconnoiter Area, and React to Contact*. The subtasks were *Engage Targets with an M16A1 or M16A2 Rifle, Move as a Member of a Fire Team, Control Movement of a Fire Team, Perform Movement Techniques During MOUT, and Report Information of Potential Intelligence Value*.

Utilization of Findings:

The task selection process described herein serves as a model for other researchers. The training scenarios will be evaluated in the Land Warrior Test Bed, and will help confirm the value of virtual environment simulations as a rehearsal tool for soldiers and small unit leaders.

HIGH PAYOFF TASKS FOR TRAINING SOLDIERS AND SMALL UNIT LEADERS IN VIRTUAL ENVIRONMENTS

CONTENTS

LIST OF TABLES

High Payoff Tasks for Training Soldiers and Small Unit Leaders in Virtual Environments

Introduction

Training soldiers and leaders in small Infantry units (platoon, squad, and fire team) of the Army After Next has always represented a significant challenge to units. This is even truer today, as military operations become more diverse. Field training for these missions will be limited by time, cost and safety factors. New methods are needed for training soldiers and small unit leaders in the conduct of urban operations and to provide units unique opportunities to rehearse specific missions. One solution is to leverage the use of virtual environment (VE) technologies to develop the soldier's decision making and leadership skills in these areas.

The Land Warrior Test Bed (LWTB) at Fort Benning, Georgia, provides the individual soldier or small unit the opportunity to explore innovative approaches for conducting urban operations and mission rehearsal activities in virtual settings. Through the use of individual combatant simulators (ICS), soldiers can immerse themselves in virtual representations (data bases) of existing urban training sites, such as the McKenna site at Fort Benning, and conduct limited missions, e.g., clear a building, or conduct area reconnaissance. They can repeat and rehearse missions over and over to familiarize themselves with the specific procedural aspects of each task. The systems allow the soldier to examine new tactics and techniques as well. In theory, practice in these virtual environments should improve the utilization of available field training time as the soldier has already rehearsed many of the procedural aspects of the various missions.

Until recently, individual virtual environments have been unable to provide the richness of environmental cues and/or adequate response sensing mechanisms to be considered useful substitutes for natural world alternatives (Jacobs, Crooks, Crooks, Colburn, Fraser, Gorman, Madden, Furness, & Tice, 1994; see also Pleban, Dyer, Salter, & Brown, 1998; and Salter, Eakin, & Knerr, 1999, for thorough discussions on problems and issues associated with existing individual combatant simulation systems). Emerging VE technologies, such as low cost computer image generators, immersive helmet mounted displays, locomotion platforms, and intelligent computer-controlled forces have attempted to address some of these deficiencies, with varying degrees of success. However, limitations in both hardware and software must still be addressed, as well as the lack of documented effective methods, strategies, and training support packages for the use of these technologies.

Current Challenges and Objectives

To address these shortcomings, the U.S. Army Research Institute (ARI) established a four year Science and Technology Objective (STO) entitled *Virtual Environments for Dismounted Soldier Simulation, Training, and Mission Rehearsal* (1998). Participants from three organizations have joined in a collaborative STO effort to focus on selected technological and training issues that currently prevent high fidelity dismounted soldier simulation. The organizations are the Infantry Forces and the Simulation Systems Research Units of ARI, the U.S. Army Simulation, Training, and Instrumentation Command, and the Human Research and

Engineering and Information Sciences and Technology Directorates of the U.S. Army Research Laboratory.

This STO work effort focuses on a number of key technological and training issues. Technological topics include limited field of view and resolution of visual display systems, simulating locomotion, tracking weapons and body positions, creating realistic performance of computer-controlled dismounted friendly and enemy soldiers, simulation of night equipment and sensor images, and making terrain and structures dynamic. Training issues addressed include the development of effective and appropriate training strategies and methods, assessing individual and unit performance, developing training materials, and determining transfer of training from virtual to live environments.

Fundamental to the first year STO work effort was the identification of key Infantry tasks that can be cost effectively represented in virtual environments for training small unit dismounted Infantry (DI) soldiers in simulated urban operations (hereafter referred to as high payoff tasks). This report will describe the process used by the author to generate a set of high payoff tasks that are supported by currently available ICS technologies. These tasks will provide the foundation for the development of soldier and small unit leader training scenarios.

Task selection was a four-phase process. The phases involved: a) establishing an appropriate initial list of dismounted soldier tasks; b) selecting a smaller pool of tasks that are executable in existing virtual environments; c) identifying an initial set of high payoff tasks; and d) specifying a final set of high payoff tasks. The entire process is fully described in the following sections.

Establishing an Appropriate Initial List of Dismounted Soldier Tasks

An initial search was conducted to identify existing task lists that had been created recently. The search revealed two potentially relevant task lists. The final set of high payoff tasks was based on refinements of the lists found in the Jacobs et al. (1994) report: *Training Dismounted Soldiers in Virtual Environments: Task and Research Requirements*; and Lockheed Martin Information Systems' (1997) *Training Exercises and Military Operations Functional Definition Report for Individual-to-Squad, Platoon, and Company Organization Levels.*

The two task lists did not use the same sources. Jacobs et al. (1994) relied primarily on the following documents:

- ARTEP 7-8-MTP (1988) *Mission Training Plan for the Infantry Rifle Platoon and Squad*;
- ARTEP 7-8-DRILL (1990) *Battle Drills for the Infantry Rifle Platoon and Squad*;
- ARTEP 31-807-31-MTP (1989) *Mission Training Plan for the Special Forces Company: Special Reconnaissance*;
- ARTEP 31-807-32-MTP (1989) *Mission Training Plan for the Special Forces Company: Direct Action.*

Sixty-seven tasks and drills were identified by Jacobs et al. (1994) for further analysis to determine their suitability for representation in virtual environments. Tasks identified by Jacobs et al. were accompanied by multiple ratings (from subject matter experts-SMEs) and frequency scores reflecting their standings on three key criteria: a) occurrences of task component activities; b) transfer effectiveness; and c) availability of technology to support task-related activities.

Lockheed Martin (1997) borrowed from many sources to include ARTEPs 7-8-MTP and DRILL, in addition to a number of other ARTEPs, Soldier Manuals, Special Texts, and Tables of Organization and Equipment for different Infantry units, e.g., Light, Mechanized, and for United States Marine Corps Infantry units. (See Lockheed Martin Information Systems, 1997, p. 10, for a complete list of sources used.) The author of this report focused primarily on tasks found in ARTEPs 7-8-MTP and DRILL.

Lockheed Martin (1997) identified 167 tasks and drills for possible representation in virtual environments. These tasks were also rated by SMEs for suitability for virtual environments. Suitability ratings were based on a functional performance code assigned to each task. The code reflected the degree to which existing simulation systems support the training of the task. This code was then converted to a single numerical rating by following a predetermined set of decision rules (See Lockheed Martin Information Systems, 1997, pp. 18-23). Ratings did not reflect the transfer potential, cost effectiveness or importance of the task to be simulated.

Tasks were considered for potential inclusion (by Jacobs et al., 1994, and this author) if they: a) applied to an Infantry platoon, squad, or individual within the squad; b) involved dismounted operations; c) were generally applicable to virtual environments; and d) were available in an unclassified mode [See Jacobs et al. (1994), p. 13].

Tasks not considered (by Lockheed Martin, 1997) for selection for the final high payoff task list included, for example, a) tasks involving passive activities such as selecting temporary fighting positions, practicing noise and light discipline; b) maintenance of weapons and equipment; c) those that deal strictly with zeroing weapons and the aligning and calibrating of equipment; or d) tasks dealing with operational and safety checks of weapons and equipment; and e) tasks in which the users are mounted in any kind of vehicles (ground, aircraft, boats) with the possible exception of selected Bradley Fighting Vehicle tasks to accommodate the mounting and dismounting of the vehicle (See Lockheed Martin Information Systems, 1997, pp. 14-17). (Tasks involving the zeroing or alignment of items of equipment, e.g., night vision, thermal, and acquisition and aiming devices, with their associated weapons were retained for possible selection). In addition, the author eliminated thirty-five of the lowest rated tasks from Lockheed Martin's initial list of 165 tasks. These tasks were judged as unsuitable for inclusion in the virtual training scenarios, e.g., *Cross Water Obstacles, Establish a Roadblock, Occupy Observation Post*.

Selecting a Smaller Pool of Tasks that are Executable in Existing Virtual Environments

From this initial combined set of 199 tasks and drills, the author examined candidate tasks and drills by applying the criteria described in the following sections. These criteria were

essentially the same or slightly modified versions of those Jacobs et al. (1994) used in rating each task [a) occurrences of task component activities; b) transfer effectiveness; and c) availability of technology to support task-related activities]. In addition, another criterion was applied to the tasks - the cost effectiveness/feasibility of performing behaviors in virtual environments (See Appendix A and B for a complete listing of all 199 tasks and drills).

Behaviors Supported by Current and Near-Term Simulation Technology

Tasks were evaluated, in part, based on the current and near-term capabilities of available ICS systems to support the behaviors or activities associated with the task. Task assessments were based on features characteristic of the Soldier Visualization Station (SVS), which will be used during the summer 1999 preliminary evaluation of small unit soldier and leader tasks/scenarios. The SVS is a PC (Pentium) based system with an inertial/acoustic tracker that can be used for aiming and looking around the corners of buildings. Movement is accomplished by applying pressure to a weapon-mounted thumbstick. Earlier research (Salter et al., 1999) showed that the prototype version of the SVS is the best performing of currently existing ICS systems. Results from the preliminary scenario evaluations will feed into a more comprehensive follow-on evaluation involving nine immersive SVS simulators and one desktop system, collectively termed the Squad Synthetic Environment (SSE) [see Salter et al. (1999) for a full description of the original SVS system and its variant].

If the SVS system could not support the critical behaviors that compose the major aspects of the task, then the task was not selected. Using this criterion, examples of tasks not selected included those involving the operation and use of such weapons as the M60 machine gun, M249 machine gun, M203 grenade launcher, M9 pistol, M47 antitank weapon, M18A1 claymore mine, and various pieces of night vision equipment (e.g., night vision sight, thermal viewers, night vision goggles). [The SVS does not yet support night work or these other weapons].

It is important to note that while Lockheed Martin (1997) acknowledged the importance of individual combatant simulation systems in supporting specific human behaviors and activities, their task selections were based on more general considerations (see p. 3 herein and Lockheed Martin Information Systems, 1997, p. 18). Jacobs et al. (1994) broke their tasks down into behaviors or activities that could be supported by current, mid- or far- term technology. This categorization was used to help identify promising tasks for final selection for use on the SVS.

Analysis of Jacobs' et al. (1994) projections on the availability of various technologies to support key task behaviors shows that progress has been slower than anticipated in certain areas. Some technologies identified by Jacobs et al. in 1994 as being available in the next 30-42 months to support various behaviors are still not completely developed in 1999. The most problematical area involves instances where the soldier must actively manipulate the virtual terrain in some way. This dynamic interplay between soldier and terrain includes such activities as construction of field fortifications (e.g., digging foxholes, hasty firing positions, or fighting positions with overhead cover), removing signs of presence, camouflaging fighting position, activating demolitions, camouflaging trails after passing, and crossing water obstacles. Since the current

SVS system is not capable of supporting these activities, tasks involving these or similar activities were not considered for selection.

Transfer Value

Tasks were selected, in part, based on Jacobs' et al. (1994) ratings estimating the transfer effectiveness of practicing component activities individually in a virtual environment. Jacobs et al. based their assessment on the following criteria: a) the primary sensory and effector modalities used to perform the task; b) the projected performance of the virtual simulation subsystems to realistically simulate the task using primary and secondary modalities; and c) the likelihood that virtual simulation artifacts may affect a negative transfer of training (e.g., simulator response latencies, visual resolution). Tasks regarded as having potentially high transfer value were, in general, composed of highly generalizable activities. Tasks involving the types of activities shown in Table 1 were rated by Jacobs et al. as potentially high in transfer effectiveness.

Frequency of Occurrence

Another consideration in determining whether or not a task was selected as a potentially high payoff task was the frequency with which underlying component activities occur in performing the tasks. Jacobs et al. (1994) analyzed each ARTEP task to identify the fundamental behaviors. Frequency counts were made of the total number of times a behavior occurred across all 67 tasks and for each individual task. Based on the Jacobs et al. analysis, activities occurring 25 or more times across all tasks were retained for further analysis. While there were a few exceptions, activities meeting this criterion were examined separately for selected tasks (generally, tasks supported by current and near-term simulation technology and rated high in transfer value by Jacobs et al.). Task selections were based, in part, on the frequency with which the actions occurred in performing the task, typically, three or more times, and on subjective judgments of the criticality of the action to the performance of the task, i.e., is the action a core component of the task?

This selection process was performed only on the tasks identified by Jacobs et al. (1994) and, by extrapolation, to matching tasks found in Lockheed Martin's (1997) list. Tasks identified for potential inclusion on the final list generally included such activities as shown in Table 1 which is based on Jacobs' et al. frequency counts.

Table 1

Representative Behaviors Rated High in Transfer Effectiveness and Frequency of Occurrence in the Performance of Infantry Tasks

Activity	High Transfer	Occur Frequently
Communication		
▪ Give verbal orders	X	X
▪ Hear orders		X
▪ Give hand and arm signals	X	X
Weapon Engagement		
▪ Aim and fire individual weapon	X	X
Visual Identification-People		
▪ Perceive relative position of other units	X	X
▪ Visually search for enemy	X	X
▪ Identify actual squad members		X
▪ Identify activity of personnel	X	X
▪ Identify enemy soldiers	X	X
▪ Identify civilians	X	
Visual Identification-Location		
▪ Identify safe and danger area	X	X
▪ Identify support position	X	X
▪ Perceive relative position of weapon fire	X	X
▪ Identify areas that mask supporting element fires	X	X
▪ Identify overwatch position	X	X
▪ Identify covered and concealed route	X	X
▪ Identify assigned sectors	X	X
▪ Estimate distance from self to distant point	X	X
▪ Discern location within area	X	
▪ Identify firing positions in a building	X	
Movement		
▪ Move in accordance with directions	X	X
▪ Maintain position relative to other personnel	X	X
▪ Move upright tactically		X
▪ Move upright, reconnoiter		X

Note: This table summarizes Jacobs' et al. (1994) ratings for these two criteria.

Cost Effectiveness/Feasibility of Performing Activities in Virtual Environments

The final criterion for task selection was the cost effectiveness/feasibility of performing the task (and its component activities) in the virtual environment in the near-term. Tasks from Jacobs et al. (1994) that had been rated (by Jacobs et al.) across the three previous criteria (behaviors supported by current simulation technology, transfer value, frequency of activity) and matching tasks from Lockheed Martin (1997) were individually analyzed by the author. Tasks and their component activities that could not be supported by current simulation technology were classified as non-feasible and eliminated from further consideration. Those tasks and component activities that received low ratings for transfer effectiveness or whose component activities did not meet the frequency criterion described earlier were deemed non-cost effective and thus, unsuitable for the current SVS system.

Tasks from both Jacobs' et al. (1994) and Lockheed Martin's (1997) lists that were judged to be non-cost effective and/or feasible for performance in virtual environments tended, for the most part to involve exfiltration/infiltration tasks (e.g., *Infiltrate/Exfiltrate by Air, Infiltrate/ Exfiltrate by Water*), *Helicopter and Boat Movement*, and NBC operations, e.g., *Prepare for Chemical/Nuclear Attack, React to Chemical/Biological/Nuclear Attack, Operate in a Nuclear Environment*. Simulation of NBC tasks, for example, was not considered practical for the current SVS. Similarly, tasks involving soldiers in aircraft or boats, and to a lesser extent in ground vehicles, are not cost effective to simulate from a training standpoint. For the small unit leader (or soldier), little, if any training value is provided by having soldiers simply entering and exiting air and boat craft or land vehicles.

Identifying an Initial Set of High Payoff Tasks

Based on the considerations discussed above, an initial list of potentially suitable tasks was identified. Again, there was a clear subjective component involved in trying to juggle the task (and its component behaviors) among the four major criteria. Different objectives and simulation systems with improved capabilities might have led to a different and/or an expanded set of tasks. It is important to note that the final list represents a snapshot in time based on current and short-term future capabilities of existing prototype simulation systems (i.e., the SVS). Table 2 combines the tasks/drills from both Jacobs' et al. (1994) and Lockheed Martin's (1997) original task lists that were identified as potentially suitable for dismounted Infantry small unit training in virtual environments, with a particular emphasis on urban operations.

Table 2

Potential High Payoff Tasks for DI Small Unit Training in Virtual Environments

Tasks	Jacobs et al. (1994)	Lockheed Martin (1997)
Movement		
▪ Move as a Member of a Fire Team		X
▪ Move Dismounted	X	X
▪ Move Tactically	X	X
▪ Perform Movement Techniques During MOUT		X
▪ Control Movement of a Fire Team		X
MOUT		
▪ Enter a Building and Clear a Room-Squad (Drill)	X	X
▪ Defend MOUT/Building	X	X
Reconnaissance		
▪ Recon Objective	X	X
▪ Report Information of Potential Intelligence Value		X
▪ Reconnoiter Area	X	X
▪ Engage Targets with an M16A1/A2 Rifle		X
▪ Execute Assault	X	X
▪ Perform Overwatch/Support by Fire	X	X
▪ Perform Hasty Ambush	X	X
▪ React to Contact (Battle Drill)	X	X

<u>Note</u>: Move Dismounted and Recon Objective were not specifically listed by Jacobs et al. (1994) but were judged as integral aspects of the respective tasks Move Tactically and Reconnoiter Area.

The combination of task lists yielded some redundancy, e.g., *Assault, Overwatch, Hasty Ambush, Defend Built-Up Area/MOUT-Building*. After further analysis of the tasks shown in Table 2, it was apparent that Lockheed Martin's (1997) task list represented a combination of tasks from FM 7-8 and component task activities similar to those identified by Jacobs et al. (1994). Indeed, these behaviors appeared more like subtasks which could be subsumed under the larger tasks from FM 7-8 identified by both sets of authors. For example, the task *Move Tactically* would include, to varying degrees, the activities (subtasks) *Moving as a Member of a Fire Team*, and *Performing Movement Techniques During MOUT*. Soldiers role playing the squad-fire team leader positions would also be responsible for *Controlling the Movement of a Fire Team*.

Engaging Targets with an M16A1 or M16A2 Rifle is a key behavioral component or subtask which underlies the tasks *Assault*, *Enter a Building and Clear a Room,* and *React to Contact*. Similarly, *Report Information of Potential Intelligence Value* was viewed as a critical subtask falling under the task *Reconnoiter Area* as well as for *Move Tactically*, *React to Contact*, *Assault*, and *Enter a Building and Clear a Room.*

Specifying a Final Set of High Payoff Tasks

Further analysis of Table 2 resulted in the elimination of some additional tasks. For example, *Overwatch* and *Defend Built-Up Area* were removed from consideration because they were judged as too passive (too little movement for individual combatants) to be effectively crafted into DI small unit training scenarios. *Hasty Ambush* was also eliminated from consideration because of the difficulty in executing the task using the prototype SVS systems in conjunction with the urban-based context of the scenarios. The final task list is shown in Table 3 with redundant/inappropriate tasks removed and the remaining ones reorganized into tasks and supporting subtasks.

Table 3

High Payoff Tasks for DI Small Unit Training in Virtual Environments

Tasks
▪ Assault ▪ Move Tactically ▪ Enter Building and Clear a Room ▪ Reconnoiter Area ▪ React to Contact
Subtasks
▪ Engage Targets with an M16A1 or M16A2 Rifle ▪ Move as Member of a Fire Team ▪ Perform Movement Techniques During MOUT ▪ Report Information of Potential Intelligence Value ▪ Control Movement of a Fire Team

Conclusion

The development of DI small unit training scenarios for near-term execution in the simulation environment will be based on the tasks and subtasks shown in Table 3. As previously noted, the selection of these tasks was based on the systematic reduction of a great number of

tasks down into a manageable, useful task list which may provide researchers and trainers the material necessary to maximize the effectiveness of individual combatant simulation for training and mission rehearsal activities. In terms of training value, these tasks should offer the highest payoff potential for soldiers and small unit leaders.

As mentioned earlier, a preliminary evaluation of the training scenarios will be conducted over the next several months. The major objectives of the preliminary evaluation are to identify scenarios (and their associated tasks) that may be performed in the simulation environment and that appear to have training value for Infantry soldiers. The training scenarios will serve as the primary instructional vehicles for the follow-on evaluation involving the Squad Synthetic Environment to be conducted later this year. The results from these evaluations will help confirm the value of virtual environment simulations as a rehearsal tool for soldiers and small unit leaders.

References

Department of the Army (1988). Mission training plan for the infantry rifle platoon and squad (ARTEP 7-8-MTP). Washington, DC: Author.

Department of the Army (1989). Mission training plan for the special forces company: Special reconnaissance (ARTEP 31-807-31-MTP). Washington, DC: Author.

Department of the Army (1989). Mission training plan for the special forces company: Direct action (ARTEP 31-807-32-MTP). Washington, DC: Author.

Department of the Army (1990). Battle drills for the infantry rifle platoon and squad (ARTEP 7-8-Drill). Washington, DC: Author.

Jacobs, R. S., Crooks, W. H., Crooks, J. R., Colburn, E., Fraser, R. E., Gorman, P. F., Madden, J .L., Furness, T. A., & Tice, S. E. (1994). Training dismounted soldiers in virtual environments: Task and research requirements (Technical Report No. 1011). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Lockheed-Martin Information Systems (1997, April). Training exercises and military operations functional definition report for individual-to-squad, platoon, and company organizational levels (CDRL-AB09. DWN-9700044A). Orlando, FL: Author.

Pleban, R. J., Dyer, J. L., Salter, M. S., & Brown, J. B. (1998). Functional capabilities of four virtual individual combatant (VIC) simulator technologies: An independent assessment. (Technical Report No. 1078). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Salter, M. S., Eakin, D. E., & Knerr, B. W. (1999). Dismounted warrior network enhanced terrain (DWN ERT): An independent assessment. (Research Report No. 1742). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

U. S. Army Research Institute for the Behavioral and Social Sciences (1998). Virtual environments for dismounted soldier simulation, training, and mission rehearsal. (STO Nomination Fact Sheet. STO No. ARI.IV.0.New 2). Alexandria, VA: Author.

Appendix A-1

Jacobs et al. (1994) Original Task List Annotated for Selection

Assault	Linkup	React to Nuclear Strike
Move Tactically	Infiltrate / Exfiltrate	Operate in NBC Environment
Reconnoiter Area	Helicopter Movement	Chem./Bio Decontamination
React to Contact	Boat Movement	Radiological Decontamination
Clear Building	Prepare for Chemical Attack	Infiltrate Area by Land
Hasty Ambush	Prepare for Nuclear Attack	Establish Contact With Asset
Defend Built Up Area	Cross Chem. Contaminated Area	Move In Denied Area
Overwatch	Cross Nucl. Contaminated Area	Establish Mission Support Site
Disengage	Cross Water Obstacle	Establish Surveillance Site
Cross Danger Area	Maintain Op. Security	Send Information by Radio
Knock Out Bunker	Defend – Air Attack	Prepare for Exfiltration
Occupy OP / Surveil	Aerial Resupply	Exfiltrate by Land
Breach Obstacle	Sustain	Exfiltrate by Water
Clear Trench Line	Prepare for Combat	Exfiltrate by Air
Antiarmor Ambush	Consolidate and Reorganize	Confirm Operation Plan
Point Ambush	Infiltrate by Air	Interdict a Target
Defend	Infiltrate by Water	Conduct Recovery Operations
Occupy Assembly Area	Conduct Assembly	Break contact
Passage of Lines	Control Info Dissemination	React to Ambush
Clear Wood Line	Employ Countermeasures	React to Indirect Fire
Occupy Objective / Rally Point	Prepare for NBC Operations	React to Chemical Attack
Occupy Patrol Base	React to Chem. or Bio Attack	React to Nuclear Attack
Stay Behind		

Note: Tasks are grouped by feasibility for use with current or near term SVS simulator technology. Items in bold type were selected as most probably useful. Items in italics were considered initially, but later judged as inappropriate for use in the small unit leader training scenarios. The remainder of the items were judged as not cost effective and/or feasible.

Appendix B-1

Lockheed Martin (1997) Modified Task List Annotated for Selection

Execute Assault	Engage Targets w/ M203 Using NVS
Battle Drill 6A Enter Bldg, Clear Room (Squad)	Restore M49 Antitank Weapon to Carrying Config.
Move as Member of Fire Team	Operate NVS AN/TAS-5
Control Movement of a Fire Team	Engage Targets w/ M47 Medium Antitank Weapon
Move Dismounted	Prepare an M47 Medium Antitank Weapon for Firing
Reconnoiter Objective	Perform Misfire Procedures on M47
Report Info of Potential Intelligence Value	Lay M60 Machine Gun Using Field Expedients
Reconnoiter Area	Prepare Range Card for M60 Machine Gun
Move Tactically	Engage Targets using M60 w/ NVS AN/PVS-4
Battle Drill 2 React to Contact (Platoon/Squad)	Zero NVS AN/PVS-4 to M60 Machine Gun
Perform Movement Techniques During MOUT	Restore M136 Launcher to Carrying Configuration
Engage Targets w/ M16A1 or M16A2 Rifle	Perform Misfire Procedures on M136 Launcher
Perform Overwatch/Support by Fire	Operate Night Vision Sight AN/PVS-4
Perform Hasty Ambush	Operate Night Vision Goggles AN/PVS-5
Defend MOUT/Building	Operate Thermal Viewer AN/PAS-7
Adjust Indirect Fire	Battle Drill 1A Squad Attack
Prepare/Submit NBC 4 Reports	Battle Drill 3 Break Contact (Platoon/Squad)
Transmit Voice USMTF Message	Guide Helicopter to a Landing Point
Conduct Unmasking Procedure	Encode and Decode Messages Using KTC 600
Prepare/Submit NBC 1 Reports	Clear a Misfire
Install Hot Loop	Prepare Platoon Early Warning System AN/TRS-2
Operate Telephone Set TA-312/PT	Issue an Oral Operation Order
Recover Mechanical Ambush	Move as Member of M2 BFV Rifle Team
Install Mechanical Ambush	Execute Attack
Operate M9 Pistol	Perform Voice Communications
Engage Targets with M249 Machine Gun	Protect Self from Bio/Chem Injury w/ Prot. Mask
Lay M249 Machine Gun Using Field Expedients	Perform Antiarmor Ambush
Operate M249 Machine gun	Orient a Map Using Lensatic Compass
Construct Firing Aids for M16A1 or M16A2	Perform Actions in Danger Areas
Zero Night Vision Sight for M16A1 or M16A2	Defend Against Air Attack
Engage Target with M16A1 or M16A2 w/ NVS	Perform Function Check on M16A1 or M16A2
Const. Firing Aid for M203 Grenade Launcher	Load M16A1 or M16A2 Rifle
Zero NVS to M203 Grenade Launcher	Battle Drill 4 React to Ambush (Platoon/Squad)

Note: Tasks are grouped by feasibility for use with current or near term SVS simulator technology. Items in bold type were selected as most probably useful. Items in italics were considered initially, but later judged as inappropriate for use in the small unit leader training scenarios. The remainder of the items were judged as not cost effective and/or feasible.

Appendix B-1 (continued)

Lockheed Martin (1997) Modified Task List Annotated for Selection

Battle Drill 5A Knock Out Bunker (Squad)	Measure Distance on Map
Battle Drill 7A Enter/Clear Trench (Squad)	Perform Surveillance w/o Electronic Devices
Unload M16A1 or M16A2 Rifle	Lay M60 Machine Gun w/ Field Expedients
Obtain Magnetic Azimuth w/ Lensatic Compass	Prepare Range Card for M60 Machine Gun
Engage Targets with M60 Machine Gun	Perform Function Check on M60 Machine Gun
React to Flares	Employ Hand Grenades
Protect From NBC Injury w/ MOPP Gear	Employ M18A1 Claymore Mine
Locate Target by Grid Coordinates	Move Under Direct Fire
Prepare M136 Launcher for Firing	React to Indirect Fire While Dismounted
Use KTC-600 Numerical Cipher/Auth. System	React to Nuclear Hazard
Locate Target by Shift from Known Point	React to Biological or Chemical Attack/Hazard
Control Organic Fires	Evaluate a Casualty
Issue a Warning Order	Report Casualties
Conduct Troop Leading Procedures for Operation	Request Medical Evacuation
Install. Planning/Install. of Platoon EWS	Report Explosive Hazard
Conduct Maneuver of M2 BFV Rifle Team	Use M256 or M256A Chemical Agent Detector
Execute Disengagement	Receive Voice USMTF Message
Perform Point Ambush	Conduct Breach of Minefield
Execute Defense	Conduct Defense by a Squad
Occupy Assembly Area	Consolidate Squad Following Enemy Contact
Load M60 Machine Gun	Reorganize Squad Following Enemy Contact
Unload M60 Machine Gun	Direct Unit Air Defense
Locate Unknown Point on Map/Grnd by Intersect.	Implement Mission-Oriented Protective Posture
Perform Linkup	Install/Recover Communications Wire Lines
Perform Infiltration/Exfiltration	Mark NBC Contaminated Area
Perform Relief Operations	Challenge Persons Entering Your Area
Perform Passage of Lines	Prepare Positions for Crew-Served Weapons in MOUT
Perform Surveillance from Observation Post	Monitor Platoon Early Warning System AN/TRS-2
Consolidate and Reorganize	Issue Fragmentary Order
Estimate Range (Sniper)	Select Hasty Firing Positions During MOUT
Provide Guides (Scout)	Conduct Maneuver of Squad
Recover M18A1 Claymore Mine	Conduct Leader's Reconnaissance
Determine Location on Ground by Terrain Assoc.	Prepare an M2 BFV Rifle Team Sector Sketch

Note: Tasks are grouped by feasibility for use with current or near term SVS simulator technology. Items in bold type were selected as most probably useful. Items in italics were considered initially, but later judged as inappropriate for use in the small unit leader training scenarios. The remainder of the items were judged as not cost effective and/or feasible.